Watermelon

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Scientific Name and Introduction: Watermelon, *Citrullus lanatus* (Thunb.) Matsum. and Nakai, is an annual plant of the Cucurbitaceae family. The edible fruit is produced on trailing vines that may reach 15 ft. (4.6 m) or more in length. Fruit vary in shape from globular to oblong. The color of the hairless skin varies in shades of green from pale yellowish to almost black and may be solid, striped, or marbled. Fruit have a thin, firm outer rind, a layer of white-fleshed inner rind that may be up to about one inch thick, and an interior edible pulp containing seeds unless the variety is triploid. Pulp color of most commercial varieties is some shade of yellow or red (Sackett, 1974).

Quality Characteristics and Criteria: High quality watermelons should be well formed, symmetrical and uniform in shape with a waxy, bright appearance. The rind should be free of scars, sunburn, and abrasions with no bruising or other physical injury, free from anthracnose or other decay, and not overripe (Suslow, 1999; USDA, 1978).

Horticultural Maturity Indices: As watermelons reach horticultural maturity, the ground spot changes from white to pale yellow, tendrils nearest the fruit may turn brown and dry, and the fruit surface may become irregular and dull rather than bright or glossy. Experienced harvest managers may note that when the fruit is thumped or rapped with the knuckles, immature fruit give off a metallic ringing sound while mature fruit will sound dull or hollow. The most reliable method of determining maturity within a given field is to visually examine the fruit for the changes described above, then cut some fruit in random sectors of the field to check flavor and internal color development. Some buyers require that fruit have some minimum SSC which is easily measured with a refractometer (Sackett, 1974; Rushing et al., 2000).

Grades, Sizes and Packaging: Watermelon grades are U.S. Fancy, U.S. No. 1., and U.S. No. 2. Determination of grade is subjectively based on the quality characteristics and criteria described above. Size may be specified in terms of average weight, minimum weight, or minimum and maximum weight (USDA, 1978). Watermelons may be shipped in bulk, placed on corrugated bins with a capacity of approximately 1,000 lb (454 kg), or packed into cartons containing from 3 to 6 watermelons depending on fruit size. Cartons should have specially designed inserts to help support the weight of the fruit (Close et al., 1971).

Pre-Cooling Conditions: Watermelons generally are not pre-cooled and some are shipped in unrefrigerated trucks (Suslow, 1999). If pre-cooling is implemented, forced-air cooling would be the method of choice. In common room-cooling, good air circulation between palletized boxes is essential. Fruit that are placed in bulk fiberboard bins will cool slowly because of poor air circulation within the bin.

Optimum Storage Conditions: Some variability is noted in watermelon varieties and types, ie., seeded vs. seedless, but in general none are suited to very long term storage. The ideal storage temperature is in the range of 10 to 15 °C (50 to 59 °F) with approximately 90% RH. Fruit should be consumed within 2 to 3 weeks following harvest (Hardenburg et al., 1986).

Controlled Atmosphere (CA) Conditions: Watermelons generally do not respond well to CA or to MAP. Studies with shrink-wrap packaging of individual fruits, a form of MAP, was not beneficial and in

some cases decay in MAP was higher (Biglete, 1992).

Retail Outlet Display Considerations: Watermelons are usually sold from unrefrigerated displays. Bulk fiberboard bins with colorful graphics have been a popular method of displaying watermelons for retail sale.

Chilling Sensitivity: Watermelons develop chilling injury when stored below about 10 °C for more than a few days. Lower temperatures will hasten the onset of injury. Symptoms appear as brown-staining of the rind, surface pitting, deterioration of flavor, fading of flesh color, and increased incidence of decay when returned to room temperatures (Hardenburg et al., 1986; Rushing et al., 2000; Suslow, 1999). Conditioning fruit at 30 °C for about 4 days prior to cooling has been shown to induce some tolerance to chilling temperatures, but it does not completely alleviate the problem (Picha, 1986).

Ethylene Production and Sensitivity: Watermelons are classified as low ethylene producers, with production rates in the range of 0.1 to 1.0 μL kg^{-1} h^{-1} at 20 °C. Although production rates are low, fruit are extremely sensitive to ethylene. Exposure to as little as 5 ppm ethylene causes softening, rind thinning, flesh color fading, and over-ripeness (Elkashif et al. 1989; Suslow, 1999). Interactions between ethylene concentration, temperature, and duration of exposure are not well defined. The recommended management protocol is to avoid any exposure to ethylene in the storage environment.

Respiration Rates:

Temperature	mg CO_2 kg^{-1} h^{-1}
4 to 5 ºC	3 to 4
10 ºC	6 to 9
20 to 21 ºC	17 to 25

To get mL kg^{-1} h^{-1}, divide the mg kg^{-1} h^{-1} rate by 2.0 at 0 °C (32 °F), 1.9 at 10 °C (50 °F), and 1.8 at 20 °C (68 °F). To calculate heat production, multiply mg kg^{-1} h^{-1} by 220 to get BTU per ton per day or by 61 to get kcal per metric ton per day. Data are from Hardenburg et al. (1986).

Physiological Disorders: Refer to sections on "Chilling Injury" and "Ethylene Sensitivity." A disorder of pre-harvest origin that can have serious postharvest consequences for marketing is hollowheart. The most effective way of eliminating hollowheart from the marketing chain is to utilize production practices that prevent its occurrence.

Postharvest Pathology: A variety of pathogens may cause postharvest decay of watermelon, but in the absence of any approved chemical control measures, the primary defense against the occurrence of decay is the exclusion of diseased fruit from the marketing chain through careful selection at harvest and appropriate grading before shipment. Postharvest rots caused by *Fusarium* spp. and *Phytophthora capsici* are of concern because control measures for these fungi in the field often are inadequate. With good disease control in the field, anthracnose (*Colletotrichum orbiculare*) and black rot (*Didymella bryoniae*) rarely develop on watermelon (Rushing et al., 2000; Snowdon, 1992). In production areas with high RH and temperature, an extensive list of rind lesions, stem-end or blossom-end rots, and surface lesions may be caused by *Erwinia* or an assortment of fungi (Snowdon, 1992; Suslow, 1999). Watermelon fruit blotch (*Acidovorax avenae* subsp. *citrulli*) was a postharvest problem for several years, but research demonstrated the disease is not easily transmitted from fruit to fruit after harvest. Appropriate grading and temperature management can virtually eliminate its presence in the marketing chain (Rushing et al., 1999).

Quarantine Issues: Watermelons destined for export must be free of disease, insects, soil, or vegetative

debris. Phytosanitary requirements in the receiving country should be reviewed prior to shipment.

Suitability as Fresh-cut Product: The fresh-cut market for watermelon cubes and slices has grown dramatically in recent years, but most processing is done near the point of sale. Some benefits may be derived by MAP. Fresh-cut watermelon is badly damaged by rough handling stress imposed during distribution (Sargent, 1998).

Special Considerations: Special care should be given to avoid rough handling injury of watermelon fruit during harvesting and handling. Fruit that are inadvertently dropped during harvest or handling should not be shipped. Injury that may not be obvious at the moment it occurs can develop into bruised areas and damage to the flesh in-transit.

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